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Procedures for Cleaning Fluorhaltiger Exhaust Air and Exhaust Gases

The invention concerns a procedure for the cleaning of fluorhaltiger exhaust air and exhaust gases with a gas scrubber, which washes the pollutants from the exhaust gases and that water of the gas scrubber circulated in a cycle, switched on into an exhaust distance, in which at least one part of the pollutants the water is extracted.

For cleaning exhaust air and exhaust gases it is already well-known to use gas scrubbers in which the pollutants from the exhaust air and/or from the exhaust gases are washed. The water enriched with pollutants circulates in one water circulation, in which filter for separating the solids are arranged. The avoidance of a too high concentration at soluble pollutants a part of the circulating water always becomes as

Waste water exhausted and this part by fresh water replaces. This leads to the fact that now in place of air the waste water with pollutants is excessively contaminated. This procedure fails, as soon as large quantities of soluble pollutants result. With brickyards, foundries, galvanic shop enterprises and during the waste incineration arise as pollutants primarily sulphur dioxide, sulfur tri oxide, hydrogen chloride and hydrogen fluoride. Besides there is oxides of the nitrogen and the phosphorus, whose removal causes difficulties.

For washing the pollutants from the exhaust air or the exhaust gases for example equipment is used, with which at the intake of a nozzle water sprays finely the exhaust air and/or the exhaust gases is admitted. At the end of the nozzle a separator is intended, in which the exhaust air and/or the exhaust gases is separated from the water. With a such (reading washing plant is in particular problematic the enrichment of the water with soluble pollutants, since with increasing pollutant concentration the receptiveness of the sprayed water decreases. Here even the effect can occur that with very hot exhaust gases in the sprayed water contained pollutants from this verduesten water are driven out, which means that the exhaust gases will load additionally with gaseous pollutants. One is forced to spray if possible fresh water whereby the water consumption becomes very substantial.

Suggested in accordance with the available invention will muddled, with which the water soluble of pollutants contained in the water circulation

the cycle to be extracted and as innocuous salts separated.

With a procedure of the kind initially specified this is reached according to invention by the fact that into the water circulation at least one anion exchanger is switched, which is regenerated in distances by caustic potash solution (KOH), whereby in such a way received potassium salts under Beigabe are supplied by calcium hydroxide Reaction distance to be supplied and the calcium salts received thereby with the potassium caustic solution, received thereby, is separated. Preferably the calcium salts in a filter can be collected. As effective ' anion exchangers on the basis of styrene worked satisfactorily. Preferably two such anion exchangers are parallel switched and an exchanger with caustic potash solution is regenerated only in each case, so that a continuous enterprise is ensured.

The figure points schematically a plant to the execution of the procedure according to invention.

The exhaust gases loaded with pollutants are supplied to a gas scrubber 1. This gas scrubber 1 exhibits several nozzles 2 at the entrance of a cone shaped channel 3. In these nozzles 2 water is sprayed, which will load with the

pollutants. In the separator 4, which consists of a larger water basin, the cleaned ' exhaust gases are separated from the water, which is loaded with the pollutants now. The water of the separator 4 arrives in a dirt filter 5, in which the solids are separated. Then the water arrives

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by at least one the anion exchanger 6,6'. From the anion exchangers the water comes into a receptacle 7. From the receptacle 7 a part of the water arrives at the nozzles 3, protecting the remaining water is led back into the water tank of the separator 4. A fresh water line 8 replaces the missing water by fresh water supply into the receptacle 7. The fresh water line is further connected with the intake - of the anion exchanger 6, 6', so that this occasionally with fresh water flushes becomes "to be able. With the intake of the anion exchangers 6,6' connected is also a container 9 for caustic potash solution.

If one is to be regenerated the anion exchanger 6,6', he is switched off by the normal water circulation and caustic potash solution is supplied to the anion exchanger which can be regenerated. The arising reaction products arrive of made of run of the anion exchanger a outer reaction distance 10 which can be regenerated, whereby at the beginning calcium hydroxide is added to the reaction distance at the same time, which is provided with stock in a container 11. The calcium salts existing at the end of the reaction distance in a fine filter 12 are collected, while water and caustic potash solution are exhausted as waste water.

The arising reactions are described in the following on the basis by sulphur dioxide, hydrochloric acid, sulfur tri oxide and hydrogen fluoride. The equation I represents the reaction of the appropriate pollutant with water, which arises, if the pollutant

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with the water into contact comes. The equation II represents the reaction in the exchanger 6,6', whereby the anions are exchanged in each case approximately hydroxyl ions OH.

With the following regeneration in accordance with equation III caustic potash solution KOH is supplied, so that potassium salts form, whereby hydroxyl ions by new to the exchanger material are angelagert at the same time. These potassium salts are soluble and poisonous partly, which applies in particular to potassium fluoride. Therefore in the reaction distance 10 a reaction is accomplished in accordance with equation IV, whereby calcium hydroxide is added to potassium salts, "so that the potassium is exchanged against calcium. In this way calcium salts and caustic potash solution develop, whereby the latter can be added in diluted measure to the waste water without heistation.

Sulfer Dioxide
(SEE ORIGINAL FOR FORMULAS)

Hydrochloric Acid
(SEE ORIGINAL FOR FORMULAS)

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Sulfer Trioxide
(SEE ORIGINAL FOR FORMULAS)

Hydrogen Flouride
(SEE ORIGINAL FOR FORMULAS)

Accordingly the reactions run off, if carbonate ions CO_3, hydraulic carbonate ions HCO_3, nitrate ions NO_3, and phosphate ions PO_3 are present.

Used with attempts as exchanger material "Kastell A 500 LAV 21" which of styrene consists. The concentration of the chlorine ions at the intake to the anion exchangers was appropriate for between 55 mg/L and 1.400 mg/L. The chlorine ion concentration at the discharge of the anion exchangers was appropriate for between 6,5 mg/L and 9.5 mg/L. The concentration of the sulfite ions SO_3 amounted to at the intake that anion more anion exchanger between 132.3 mg/L and 2,457 mg/L.

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On the discharge of the anion exchangers a sulfite ion concentration between was based 0.1 mg/L and 0.2 mg/L. The concentration at fluorine ions was to because of the intake of the anion exchangers between 9.5 mg/L and 95 mg/L. At the discharge of the anion exchangers fluorine ions could be recognized no longer.

The procedure according to invention is limited not necessarily to exhaust gases and exhaust air, the hydrogen fluoride contains. In the context of the invention also exhaust gases and exhaust air can be treated, with which no fluorine is contained. The main field of application will be appropriate however with fluorine Haiti towards gases, since the removal of the fluorine is from special problem.

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Requirements

PATENT CLAIMS

I. Procedure for cleaning fluorhaltiger exhaust air and exhaust gases with a gas scrubber, which washes the pollutants from the exhaust gases and which water of the gas scrubber circulated in a cycle, switched on into an exhaust distance, in which at least one part of the pollutants is extracted from the water, by the fact characterized that into the cycle at least one anion exchanger is switched, which was away in by caustic potash solution regenerates i becomes, whereby in such a way received potassium salts under Beigabe of calcium hydroxide one reaction-eat-strained is supplied and the calcium salts with the potassium caustic solution, received thereby, is separated.

2. Procedure according to requirement I, by the fact characterized that the calcium salts in a filter are collected.

3. Procedure according to requirement I, by the fact characterized that the anion exchanger consists of styrene.

4. Procedure according to requirement I, or 3, by the fact characterized that 2 anion exchangers are parallel switched and an exchanger with caustic potash solution is regenerated only in each case.

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TRANSMITTAL FORM

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First Named Inventor	Juzer Jangbarwala
Art Unit	1793
Examiner Name	Ngoc Yen M. Nguyen
Attorney Docket Number	M03A205-CIP

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☑ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☑ Extension of Time Request
- ☐ Express Abandonment Request
- ☑ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
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- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☐ Other Enclosure(s) (please Identify below):

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Edwards Vacuum, Inc.		
Signature	Mary K Nichols		
Printed name	Mary K. Nicholes		
Date	July 10, 2008	Reg. No.	56,238

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Signature	Betty Lee		
Typed or printed name	Betty Lee	Date	July 10, 2008

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Juzer Jangbarwala

Serial No.: 10/759,718

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Title: FLUORINE REMOVAL BY ION EXCHANGE

Group Art Unit: 1793

Examiner: Ngoc Yen M. Nguyen

Attorney Docket: M03A205-CIP

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AMENDMENT

In response to the Office Action dated January 10, 2008, Applicants submit the following Amendments and Remarks.

Amendments begin on page 2.

Remarks begin on page 4.

IN THE CLAIMS

1. (currently amended) A method for removing fluorine gas from a selected environment, comprising the steps of:

(a) contacting the fluorine gas from the environment with a selected quantity of water in an ion-exchange resin, thereby to generate an acidic solution of hydrofluoric acid; and

(b) contacting said acidic solution of hydrofluoric acid with ~~an~~ the ion-exchange resin having an active state operative to exchange selected ions therein for fluoride ions in said acidic solution when in contact therewith,

wherein said ion-exchange resin is capable of chemically shifting between said active state and an exhausted state operative to exchange the fluoride ions in said ion-exchange resin for the selected ions contained in a regenerant solution when in contact therewith, and including the step of regenerating said ion-exchange resin by contacting said ion-exchange resin with the regenerant solution thereby to form a selected regenerant waste product containing the fluoride ions, and

wherein said regenerant solution is selected from the group consisting of ammonium hydroxide solution, waste ammonium hydroxide solution, and any combination thereof.

2. (original) The method according to claim 1 wherein the regenerant solution is waste ammonium hydroxide solution.

3. (currently amended) ~~A~~ The method according to claim 1 wherein the waste ammonium hydroxide solution is generated from one or more processes associated with the fluorine gas from a selected environment.

Claims 4-6 (cancelled)

7. (new) The method according to claim 1 comprising the step of providing a vacuum pump wherein the step of contacting the fluorine gas from the semiconductor process with a selected quantity of water in the ion-exchange resin comprises exhausting the fluorine gas from the vacuum pump into the selected quantity of water.

8. (new) The method according to claim 2 wherein the waste ammonium hydroxide solution is generated from a chemical-mechanical polishing ("CMP") process.

REMARKS

Claims 1-3 are pending in the application and claims 7-8 are new. Support for new claim 7 is found in paragraph [0063] and support for new claim 8 is found in paragraph [0042]. No new matter has been introduced. The Examiner has rejected claims 1-3. Applicant respectfully traverses the rejection and seeks favorable reconsideration in view of the following remarks.

The Examiner rejected claims 1-3 under 35 U.S.C. § 103(a) as being unpatentable over DE 2 300 129 A ("DE '129") in view of JP 07-232,915 ("JP '915"). Notably, Applicant has enclosed an Information Disclosure Statement that provides an English translation of DE '129. The Examiner asserts that "DE '129 discloses a process and apparatus for purifying waste gas or air containing fluorine." Office Action, p. 2. The Examiner concedes that DE '129 fails to teach "the use of ammonium hydroxide as the regenerant." Office Action, p. 3. However, the Examiner asserts that JP '915 teaches a process for recovering F ion from waste water by contacting the F ion with ammonium hydroxide. Office Action, p. 3. In addition, the Examiner concedes that JP '915 fails to teach that the ammonium hydroxide is a waste ammonium hydroxide. However, the Examiner asserts that "it would have been obvious to one skilled in the art to use any source of ammonium hydroxide..." Office Action, p. 3. The Examiner further asserts that "[i]t would have been obvious to one of ordinary skill in the art...to regenerate the anion exchange resin in the process of DE '129 with ammonium hydroxide as suggested by JP '916 because ammonium hydroxide can be used effectively to regenerate the anion exchange resin." Office Action, p. 3-4. Applicant respectfully traverses the rejection and seeks favorable reconsideration in view of the following remarks.

Amended independent claim 1 claims "A method for removing fluorine gas from a selected environment, comprising the steps of: (a) contacting the fluorine gas from the environment with a selected quantity of water in an ion-exchange resin, thereby to generate an acidic solution of hydrofluoric acid..." Support for the amendment to independent claim 1 is found in paragraph [0038] of the application as filed. No new matter has been introduced. Applicant respectfully submits that the teachings of DE '129, either alone or in combination with JP '916, fail to achieve the invention as claimed in amended independent claim 1. In contrast to the present invention, DE '129 teaches supplying the exhaust gases to a gas scrubber 1. *See* page 3 of the English translation and the Figure (element 1). DE '129 fails to teach or even suggest

contacting the exhaust gases with water in the anion exchanger 6, 6'. *See* the Figure. Accordingly, DE '129 fails to teach "contacting the fluorine gas...with a selected quantity of water in an ion-exchange resin..." as claimed in amended independent claim 1.

Like DE '129, JP '916 also fails to teach the invention as claimed in amended independent claim 1. Indeed, JP '916 teaches introducing a waste water containing F^- ion into an active carbon tower and then subsequently into a series of ion-exchange resin towers. JP '916 fails to teach or even suggest "contacting the fluorine gas...with a selected quantity of water in an ion-exchange resin..." as claimed in amended independent claim 1. Thus, JP '916, either alone or in combination with DE '129, fails to achieve the invention as claimed in amended independent claim 1. Accordingly, Applicant respectfully submits that amended independent claim 1 is not rendered obvious by DE '129, alone or in combination with JP '916 and respectfully request withdrawal of the rejection to independent claim 1.

Applicant submits that dependent claims 2-3 and 7-8 are similarly not rendered obvious by DE '129 or JP '916, alone or in combination, for at least the reasons set forth above with respect to amended independent claim 1. In addition, Applicant respectfully submits that dependent claim 2 is not rendered obvious by the teachings of DE '129 and JP '916, because they both fail to teach or even suggest regenerating the ion-exchange resin with *waste* ammonium hydroxide. Indeed, both DE '129 and JP '916 fail to teach using a waste stream as a regenerant. DE '129 teaches away from using waste ammonium hydroxide. DE '129 teaches an elaborate method of regenerating the anion exchangers using potassium liquor (KOH) and subsequently adding calcium hydroxide to the calcium salts resulting from the regeneration to assist in precipitating the calcium salts. See Abstract. DE '129 further teaches pumping the potassium liquor from a container and into the anion exchanger. *See* the Figure (element 9). In contrast to the Examiner's assertion that any caustic solution, beside KOH, may be used to regenerate the anion exchange, DE '129 fails to teach or even suggest the use of any other regenerant. Apparently the process and apparatus of DE '129 were designed around the use of KOH which called for adding calcium hydroxide to the waste stream (*See* element 11) and a fine filter (*See* element 12) to remove the calcium salts. *See* the Figure. Thus, DE '129 teaches away from using ammonium hydroxide let alone *waste* ammonium hydroxide. Similarly, DE '129 and JP '916 fail to teach or even suggest regenerating the ion-exchange resin with waste ammonium hydroxide generated from either a process associated with the fluorine gas as claimed in

dependent claim 3 or from a CMP process as claimed in dependent claim 8. The Examiner asserts that "it would have been obvious to one skilled in the art to use any source of ammonium hydroxide as long...[as it] can regenerate the basic ion-exchange resins." Applicants respectfully disagree. Neither DE '129 nor JP '916 teach or even suggest that a source of waste ammonium hydroxide was even available for use in their processes. For these further reasons, Applicant respectfully submits that dependent claims 2-3 and 8 are not rendered obvious by DE '129 either alone or in combination with JP '916.

In addition, neither DE '129 nor JP '916 teach or even suggest that "the step of contacting the fluorine gas from the semiconductor process with a selected quantity of water in the ion-exchange resin comprises exhausting the fluorine gas from the vacuum pump into the selected quantity of water" as claimed in dependent claim 7. Thus, for this additional reasons, dependent claim 7 is not rendered obvious by DE '129 and/or JP '916.

In view of the foregoing remarks and amendments Applicant respectfully submits that claims 1-3 and 7-8 are not rendered obvious by DE '129 either alone or in combination with JP '916. Accordingly, Applicant respectfully requests withdrawal of the rejection to the claims and that the application be promptly passed to issue.

Applicant has enclosed a request for a three-month extension of time. Applicant does not believe that any additional fee is due, but as a precaution, the Commissioner is hereby authorized to charge any additional fee to deposit account number 50-4244.

Respectfully Submitted,

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